

## **16000 - ELECTRICAL**

### DESIGN

#### A. ELECTRICAL MAIN SERVICES:

1. Where appropriate a three-phase four wire 277/480 volt main service is preferred. The main electrical service should have a minimum of six spare fuses of each type used in the facility. All building wiring shall comply with current NEC.
2. To comply with OSHA's lock out tag out requirements, disconnects, panel boards and all electrically powered equipment shall have a means of de-energizing and locking out the equipment for service or repairs.
3. Trapeze mounted transformers are not acceptable. Trapeze mounted transformers do not permit free and ready access for emergency repairs or for routine maintenance. This type mounting creates a dangerous work environment for employees.
4. Data and communication rooms shall be separate rooms from the electrical supply closet. This is necessary to keep cable clutter and risk of electrical shock to a minimum. All data and communications rooms shall be provided with receptacles that are powered by the emergency generator circuit. No electrical transformers or distribution panels are permitted in telephone/data or communications closets.
5. Specifications shall require Contractor to provide 1/4" = 1' scale layouts of all electrical and data/communications rooms showing panel boards, switchgear, and transformers prior to installation.
6. Specifications shall require installation of electric demand meters/monitors as part of the Building Automation System.

#### B. Emergency Standby Generator and Automatic Transfer Switch Set, if required:

1. Should contain a built-in load bank for system testing.
2. The emergency generator system shall be designed such that load shedding is not required to pick up the connected loads. Connected loads shall be limited to code requirements and operational requirements. The generator set shall be large enough to successfully start and carry all connected loads. Ten percent spare capacity shall be provided at the emergency generator to carry future loads, unless directed otherwise by DPWES.
3. Primary tanks and day tanks shall not be located or mounted on the same frame of the emergency generator. The daytank shall be mounted on a slab on grade, independent of the emergency generator. Simplex daytanks are preferred; Tramont daytanks are not acceptable. For exterior day tank,

provide day tank heater and heat tape on fuel lines. A secondary fuel pump shall be provided for the return line from the day tank, as required.

4. Package units with main fuel tanks, sub-base fuel tanks, belly tanks, on-board tanks or rail mounted tanks are not acceptable. All fuel piping and fuel tank designs should be approved by the system manufacturer of the generator set. Copper piping is not to be used for fuel supply or return. Fuel oil return piping must be provided to the daytank and the main tank.
5. The main fuel tank shall be a separate component, and shall either be a buried double wall tank or an approved above ground storage tank (AST) mounted on a slab independent of the generator. The AST shall be securely bolted to the slab and properly grounded.
6. Fuel system piping shall be black pipe, painted with corrosion resistant paint. Fuel piping return line must be properly sized per manufacturer's recommendations.
7. The emergency power distribution should be tapped ahead of the main and shall have a disconnecting means with lock out capabilities for service and repairs.
8. Where a buried fuel tank is used, a foot valve shall be provided at the tank's lowest point, to prevent air from entering the system.
9. Where a diesel generator set is used, provide a foot valve in the tank at the pipings lowest point, to prevent the possibility of air getting in the system.
10. Verify that the emergency generator system will work properly with a UPS connected to equipment tied to the system.
11. Locate generator exhaust as far from building air intakes as possible.
12. Specifications shall require the Contractor to conduct an on-site load bank test for new emergency generators, and test result must be submitted to the County (FMD).
13. A GFCI protected receptacle shall be installed on the generator frame, inside the housing, for use during maintenance.
14. A non-fusible disconnect shall be provided adjacent to the generator, connected to the load side windings, for use as a service switch during maintenance and load testing.

C. FIRE ALARM SYSTEM:

1. The installer of the fire alarm and fire suppression systems shall provide four complete sets of Maintenance and Operation manuals, parts manuals,

and list of local vendors for the system, to Fairfax County at Substantial Completion (coordinate with General Conditions).

Contractor must turn over fire alarm system keys, operations and maintenance manuals, and as built drawings at or before Substantial Completion (coordinate with General Conditions).

2. As-built prints, as-built schematic diagrams, wiring diagrams, keys to cabinets and panels, manual stations and access codes shall be submitted to Fairfax County at Substantial Completion (coordinate with General Conditions).
3. The contractor shall provide a system for which repair parts and service is readily available to the County from local vendors. The County should not be bound to an exclusive vendor for repair, maintenance or material procurement for the system or its components.
4. Fire alarm devices vary widely in their electrical characteristics and must be carefully matched with a suitable control panel to assure proper performance. Fire alarm devices, control panel and annunciator panel must be from the same manufacturer.
5. All fire alarm devices shall be readily accessible for testing, repair and maintenance purposes. All fire alarm devices located above a suspended ceiling must be clearly labeled at the ceiling. An LED light must be provided at the ceiling to show annunciation of that device, and access must be provided through the ceiling.
6. Smoke detectors shall not be located adjacent within three feet of supply or return air vents/diffusers.
7. The contractor shall be required to provide the County with replacement initiation devices and audio-visual devices, equaling 10 percent of the total number of installed devices but not less than one of each type device, within seven days of Substantial Completion.
8. The specifications shall require that the Fairfax County Project Manager and Project Engineer (Project Manager to coordinate with FMD) be informed at least 7 days in advance of the final complete test of the entire system and be allowed to witness the tests prior to the acceptance by the County. Testing shall consist of, at a minimum: smoke and alarm each smoke and duct detector, pull and reset each pull station. Specifications shall require that the Contractor provide a complete overview of the system at the time of this system test (CMD shall notify FMD fire alarm staff of the date of this test/training.)
9. The installer shall maintain the color-coding established by the manufacturer throughout the system. The terminations or connections in the control panels or junction points should be clearly marked and the corresponding field wiring should be permanently tagged.
10. Two dedicated telephone outlets are required for each auto-dialer.

11. The phone lines serving the auto-dialers shall not be hard wired; a jack shall be provided for each line to facilitate maintenance and testing.
12. Auto-dialer program and format codes shall be transmitted to FMD at the Substantial Completion walk through and a copy shall be included in the operations manual for the fire alarm system.
13. An auto-dialer shall be provided and connected to support the Fire Alarm Control Panel (FACP). The auto-dialer shall connect to the Counties contracted monitoring service as directed by FMD, PE&E section.
14. The auto-dialer, which serves the FACP, shall not serve other equipment.
15. The auto-dialer, which serves the emergency phone for elevators and lobbies, shall not serve other equipment.
16. The auto-dialer, which serves the security system, shall not serve other equipment.
17. Projects, which require an elevator, shall be provided with an auto-dialer, and connected to the emergency phones in the elevator cabs and elevator lobbies. The auto-dialer shall connect to the Counties contracted monitoring service as directed by FMD, PE&E section.
18. The FACP and the Fire Alarm Annunciator Panel (FAAP), and auto-dialer shall be programmed and or designed to automatically reset once a trouble or fault is cleared, as required by the local agency having jurisdiction.
19. The auto-dialer for the Fire Alarm system and the Elevator emergency phones shall have manual onsite reset capabilities, and shall automatically reset once the trouble or phone line or power interruption has cleared.
20. The auto-dialers shall automatically restore and or reset upon power or phone line interruption, once the power or the phone line restores and or stabilizes.
21. The auto-dialers shall be programmed to monitor/report events as required by the Fire Marshall's office. These events shall be sent via the dedicated phone lines to the Counties contracted monitoring company as directed by the FMD.
22. The auto-dialer test timer test shall be programmed to perform between 7:00 A.M. and 1:00 P.M.
23. The contractor shall arrange to receive and respond to all trouble and alarms received by the Counties monitoring service prior to building occupancy by the County.
24. The contractor shall transmit a copy of the Fire Marshall's final inspection report to FMD, O&M Branch for inclusion into the building maintenance file. This report should be provided to FMD prior to building occupancy by the County.
25. A Knox Box is required by the Fire Marshall's office for key access to buildings (see Attachment 08000-A). The contractor shall provide, install,

and coordinate location with the Fire Marshall's office, all required Knox boxes.

26. Architect must obtain the most current copy of the Code Reference Package for Architects, Engineers, Designers and Installers from the Fairfax County Fire & Rescue Department, Fire Prevention Division, Engineering Plans Review Section, and shall incorporate all requirements of that Code Reference Package into the design documents. All requirements of the Code Reference Package which are intended to be the responsibility of the Contractor shall be clearly identified as such in the contract documents.
27. Specifications must clearly state that the Contractor is responsible for paying for all shop drawing review fees and permit fees associated with the review, approval and permitting necessary for a complete fire alarm system. The Contractor shall also pay any additional costs for Fire Marshall's inspection's beyond those paid for by the Owner as part of the building permit/inspection fees.

#### D. LIGHTING

1. Lighting shall be designed for the foot candle levels listed below, with task lighting provided to supplement where higher levels are desired. All fluorescent lights shall be provided with 32-watt T-8 lamps and electronic ballasts. Recommended light fixtures are: 2 x 4 lay-in with parabolic louvers, three tubes (277 volts).
2. Light fixtures used as HVAC diffusers are not acceptable. These type fixtures limit the flexibility of the lighting system.
3. Lighting in atrium areas or in high ceiling areas should utilize HID fixtures with remote ballasts locked in a properly ventilated area. Ready access to all light fixtures is essential to properly maintain the designed lighting levels. Fixtures in high ceiling areas should be accessible from a ten-foot stepladder. Fixtures that are not readily accessible are not acceptable.
4. The use of incandescent fixtures is prohibited except when specifically approved by the Project Manager, and FMD
5. Dimming systems should not be used unless specifically required. Automatic dimming systems should be utilized in areas where "daylight" may provide all or most of the required light level.
6. Decorative, accent and neon lighting should not be used, without specific approval from the Project Manager.
7. All exterior lighting should be controlled by photo controls. The lighting controls, clocks and photo controls should be located in the main electrical room. Parking lot lighting should be provided and maintained by the local utility. Outdoor walkway lighting will be provided and maintained by the Owner and included as part of the design documents. Bollard type fixtures should not be used because they are a constant maintenance liability due to vandalism. Lighting for flagpoles should be attached to the building structure. The use of outdoor, in-ground lighting is not acceptable due to vandalism. Plans must show Contractor provided conduit for all site lighting circuits. The use of UF cabling for exterior lighting is not acceptable. All

circuits for exterior lighting shall be routed in conduit.

8. The mechanical and the electrical room lighting shall be on the standby emergency generator.
9. Where appropriate, the fuel site lighting and the power should be on the emergency generator.
10. Lighting fixtures with battery backup are not acceptable; except for emergency lighting, fixtures with battery back-up, which should be dual head, flood type fixtures (for ease of maintenance).
11. In libraries where stack lighting is to be used, there should be no ceiling light provided where it becomes inaccessible for maintenance or repairs.
12. Where low voltage controls are incorporated for local switching, a layout of the relays should be permanently placed in the facility's main electrical room and should be clearly identified.
13. Fire station hose towers should be properly illuminated for safe use for storage. The fixtures shall be water tight and accessible for repairs.
14. Day lighting or indoor electrical illumination should comply with the following standards:

Corridors, Lobbies and Means of Egress	20 foot candles
Storage Area	20 foot candles
Waiting Rooms and Lounge Areas	(task illumination with maximum back ground lighting):
General Office Areas	60 foot candles
Desk tops	30-50 foot candles
Conference Tables	60 foot candles
Secretarial Desks	30 foot candles
Filing Cabinets	30 foot candles
Book Shelves	70-100 foot candles
Drafting and Accounting	100 foot candles
Public Spaces:	
Library Reference Areas	70 foot candles
Library Reading Areas	30 foot candles
Auditoriums	30 foot candles
Cafeterias	In accordance with Illuminating Engineering Society Guidelines
Parking Structures	
15. Lighting in high bay areas such as garages, gymnasiums or warehouses should use pendant type HID type fixtures and should be easily removable for repair or replacement. Cord and plug connected is preferred. Safety chains must be provided on each fixture.
16. The site lighting shall be installed by Dominion Virginia Power under the Municipal Street lighting contract.
17. Exterior building and walkway lighting not installed and maintained by Dominion Virginia Power must be durable and vandal resistant. Metal bollard fixtures are not acceptable.

18. All wall mounted lighting control switches (and other similar wall mounted control switches) shall be toggle type switches. Rocker type switches shall not be used.

#### E. COMMUNICATIONS ROOMS

1. Communications Rooms for telephone, data, cable television, etc., must be separate from electrical rooms. No transformers or electrical distribution panels are permitted in Communications Rooms. See attachment 16000-A for typical communications room layout.
2. Flat wire systems are not to be used for communications systems
3. All communications rooms shall be provided with HVAC systems capable of maintaining the temperature of the closet between 64°F and 75°F.
4. Provide a number six (#6) ground wire run from a buss bar in each communications room to the main building ground in accordance with NEC. See Attachment 16000-C for buss bar detail.
5. A minimum of one communications room shall be provided at each floor of a facility, with additional rooms on each floor as may be required to accommodate the communications equipment and wiring requirements. Any exceptions to this requirement must be approved by the project manager. Telecommunications closets are to be sized in accordance with Electronic Industries Association/Telecommunications Industries Association (EIA/TIA) 569 Chapter 7. No cable run can be longer than 295 feet from the telecommunications closet.
6. All communications systems rooms, switch rooms, equipment, materials, wiring, and ancillary provisions shall be designed and constructed in accordance with all requirements and recommendations of the EIA/TIA Electronic Industries Association/Telecommunications Industries Association (EIA/TIA) Telecommunications Standards. Requirement for compliance with this document must be reflected on project plans and specifications.
7. Communications rooms must be of adequate size to accommodate the following requirements for County telephone, data and cable television, but in no instance shall they be smaller than the referenced standards. See Attachment 16000-B for typical communications room layouts. Additional provisions may need to be made for other communications systems.
  - a. All available wall space at communications rooms should be covered with 3/4" x 8' high fire retardant, plywood backboards. Provide a minimum of four (4) sheets of painted, wall mounted 4'x 8'x 3/4" fire retardant plywood to meet requirements for County telephone, data and cable television. Additional backboards may be required for Verizon Communications and other communications systems. All backboards are to be painted white using a non-volatile, fire retardant paint that is compatible with the fire retardant plywood

- b. Provide a minimum of four (4) quad 110-volt, 20 amp dedicated electrical outlets with isolated ground mounted at 6 inch AFF.
  - c. Provide overhead two-tube fluorescent lighting fixture(s) with coverguard and a separate wall mounted switch. At least one light per closet, which shall be tied to emergency power. Lighting levels must meet EIA/TIA standards. Minimum of 50 foot candles at 3 feet.
  - d. Provide floor space for two (2) - 24" wide by 36" deep by 79" high floor mounted, telecommunications equipment racks, and provide NEC required 36" access clearance.
  - e. Allow for a minimum of three feet of clear space on all sides of all electrical/ communications equipment per NEC.
8. Provide a 3/4" empty conduit with drawstring for each telephone, answering machine, fax machine, copy machine and computer data jack location. Telephone and data jacks for computer at the same location can utilize the same 3/4" conduit for wiring. Provide a 1" empty conduit with drawstring for each cable television (CATV) outlet. Provide a single *gang* electric box at each telecommunications/data and CATV outlet. Provide an appropriate size empty conduit stubbed above ceiling for accessible ceiling areas, and provide entire conduit system from telecomm/data and CATV outlet locations back to closet for inaccessible ceiling areas or security type areas. Provide empty conduit and boxes in concrete slabs for free standing furniture areas that will require communications outlets. *Provide Walker products for all floor box and poke through locations (see [www.wiremold/topguard](http://www.wiremold/topguard)).* An accessible wiring path must be provided from each jack back to the communications room, independent of the electrical circuits. Communications conduit requirements must be clearly shown on the electrical drawings including pull boxes. "Daisy-Chaining" or wiring of jacks in series is not acceptable.
9. Provide a minimum of five (5) four-inch empty conduits vertically and horizontally between communications rooms that will be wired in series. The number, location, and routing of these conduits is to be approved by the Project Manager prior to construction. An additional four-inch empty conduit run vertically and horizontally between communications rooms will be required for each communication system other than County telephone, data and cable television. Provide two (2) four-inch conduit(s) for Verizon and Cox CATV (four conduits total) from the main telecommunications room to the property line.
10. A system of accessible pull boxes which can be used as a junction point for several dedicated 3/4" conduit runs and which provides a property sized home-run conduit with drawstring from the pull box to the nearest communications room may be provided. This pull box and conduit system must comply with EIA/TIA; be approved by the Project Manager, and be shown on the construction documents. Locations for bushed, wall-sleeve, penetrations shall also be shown on the plans, as required.



11. Make provisions for dedicated telephone/data jacks at location of mechanical EMCS station, and at the communications closet for the fire alarm direct dialer for remote emergency monitoring.
12. All telephone, data and cable television jacks, wiring and cover plates will be furnished and installed by Owner. Empty conduit with pull strings, pull boxes, junction boxes and fit-up of communications closet with plywood, ground wire and buss bar, and electric outlets will be by Contractor.
13. All building wiring, pathways and space, grounding and bonding shall meet or exceed the EIA/TIA Telecommunications Infrastructure Standards. Project specifications shall include a separate section to address telecommunication infrastructure requirements. The following document numbers must be complied with:

EIA/TIA-569A:	Commercial Building Wiring Standard
EIA/TIA-569:	Commercial Building Pathway and Space Standard
EIA/TIA-606:	Telecommunications Administration Standard
EIA/TIA-607:	Commercial Building Grounding and Bonding Standard
EIA/TIA-TSB-67:	Testing for Telecommunications:
Technical Bulletins	TSB-36, 40, and 53

EIA/TIA Telecommunications Infrastructure Standards is available from:

Electronic Industries Association  
 Engineering Department  
 2000 Pennsylvania Avenue, N.W.  
 Washington, D.C. 20006  
 (202) 457-4966

#### F. LIGHTNING PROTECTION/GROUNDING SYSTEMS

1. Contractor must submit detailed, as-built drawings for this system. As-builts must show down rod locations, conductor routing and conductor connections sites. A copy of the UL certification for the lightning protection system must be included in the O&M manuals.
2. Contractor must submit as-built drawings for the building grounding system including rod sizes, locations, configuration and connection details.
3. Specifications shall require that the contractor obtain a UL certification for the system and submit a copy of the certificate to the Architect/Owner.

#### G. OUTDOOR RECEPTACLES

1. Use of outdoor receptacles should be minimized. Where provided, outdoor receptacles shall be designed to limit access to authorized personnel only.

## PRODUCTS

### A. ELECTRICAL MAIN SERVICES:

1. Main distribution panels, sub panels and disconnects shall be Cutler Hammer. FPE and Challenger are not acceptable. Cutler Hammer type PB panels are preferred with bolt in breakers. The type PB panels give flexibility by accepting both bolt-in and push-in breakers. Provide one stock circuit breakers for each type installed.
2. The use of aluminum cable is unacceptable. Provide only copper cable.

### B. WIRING SYSTEMS:

1. Where a floor wiring system is required, a walker duct type floor system with separate trough for electrical, computer and communication wiring is recommended. Flat wire systems are not desirable and shall not be included in the design without prior approval of the Project Manager (flat wiring must be approved in writing by the Telecommunications Division of the Department of Information Technology). Where flat wire systems are necessary, the type FCC cable system is preferred.
2. The County stocks replacement material and has the tools necessary to repair and install Thomas and Betts type FCC (Flat Cable) system. The use of other than Thomas and Betts type FCC system will require the installer to provide the County with an appropriate quantity of spare materials to make repairs to the system and the special tools necessary to make the repairs.

### C. EMERGENCY STANDBY GENERATOR AND AUTOMATIC TRANSFER SWITCH SET:

1. The emergency generator set, if required, shall be Onan, Caterpillar or Katolight. No others are acceptable.
2. The use of a Detroit V-12 engine is not acceptable.
3. Automatic transfer switch manufacturers shall be Zenith Russel Electric, or Asco.

### D. FIRE ALARM SYSTEM

1. The acceptable manufacturers for fire alarm devices, control panels, and annunciator panels are Simplex, Cerberus, and Edwards. Only listed graphic fire alarm annunciator panels (1990 BOCA 1016, 1017; NFPA 72A 1-2,2) are to be installed. See Attachment 16000-A for sample annunciator panel. All devices connected to the Fire Alarm Control Panel (FACP) shall be by the same manufacturer as the FACP.